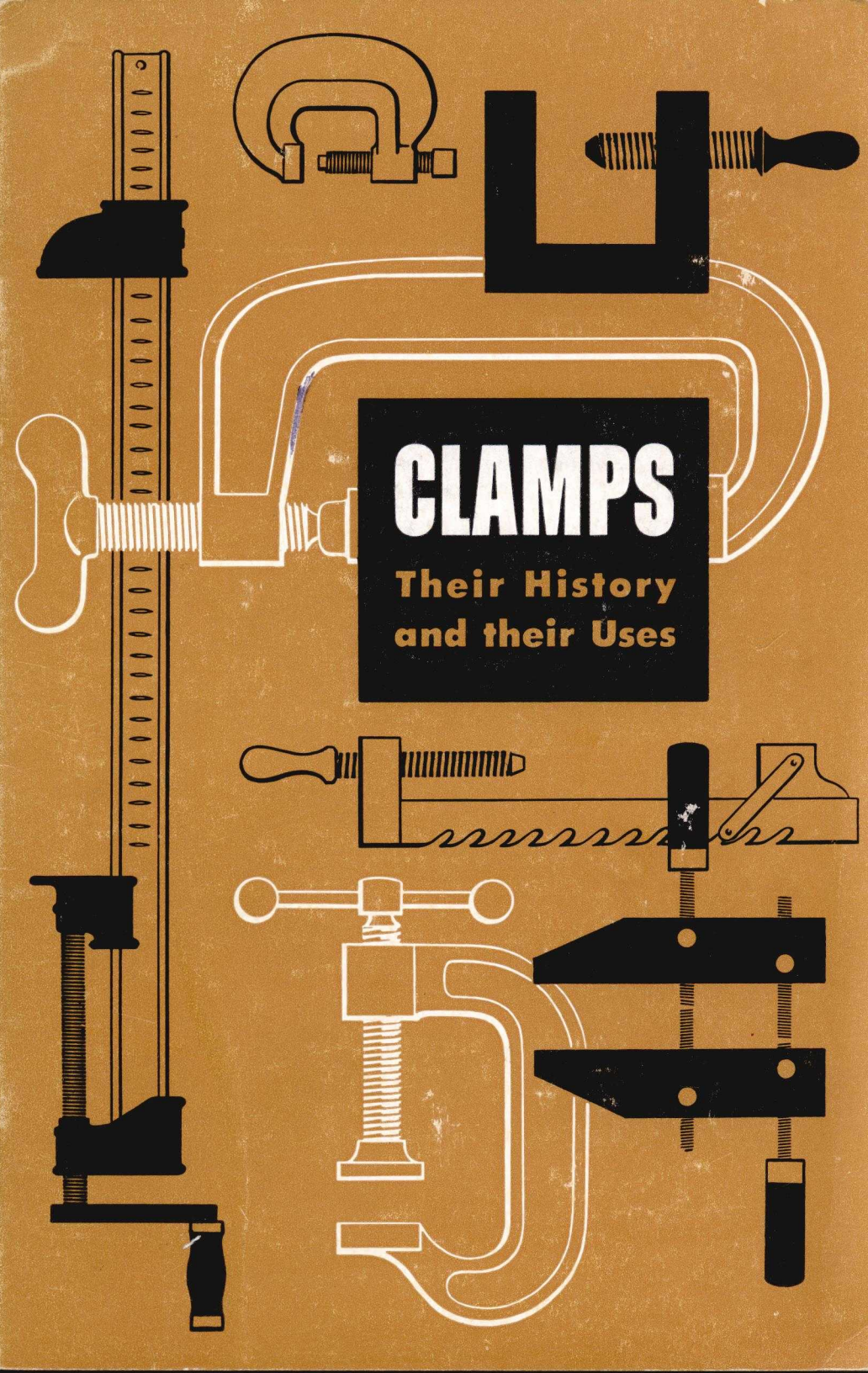
CLAMPS
Their History
and their Uses

HARGRAVE

TESTED TOOLS

The CINCINNATI TOOL Company

CINCINNATI 12, OHIO

ESTABLISHED 1879 • INCORPORATED 1884

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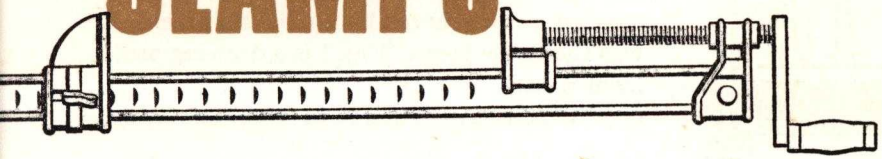
CLAMPS

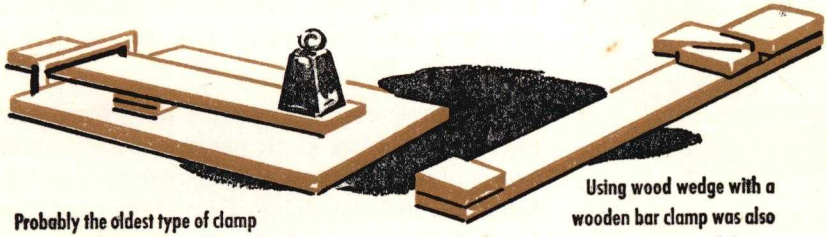
Their History and their Uses



Although the art of woodworking reached a high degree of perfection in Egypt thousands of years before the Christian Era, no evidence has been found of the use of clamping devices, neither among the tools found in Egyptian tombs nor among the murals carved or painted on their walls.

Some of these murals depict tool operations in woodworking and other trades. One picture shows a man sawing a board, but the board is not clamped. Instead, it is tied with a rope to a post driven into the ground. Another picture shows the gluing of veneer, heating the glue, brushing it on the wood surface, but instead of using a clamp, the veneer is held in place by piling sand on top of it. The wedge, however, was used to exert pressure even as it is today, not only by the Egyptians, but also by other ancient peoples.

The screw, which is now an essential part of nearly all types of clamps, was invented by Archimedes about 250 B.C. while traveling in Egypt. After noticing that the Egyptians had difficulty raising water from the Nile river for irrigation purposes, Archimedes invented a screw or spiral which was enclosed in a cylinder or pipe. When this was placed in an inclined position with its lower end under water, this screw, when revolved, lifted the water from a lower to a higher level. It was not until about three hundred years later that it was discovered that the screw could also be used to exert pressure.



Probably the oldest type of clamp was made by the cabinet maker himself.

Using wood wedge with a wooden bar clamp was also an early type of clamp.

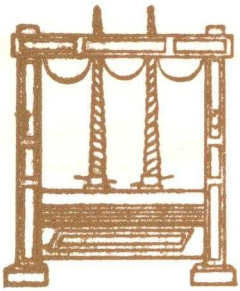


Fig. 1. Screwpress with two spindles. From a wall painting in Pompeii.

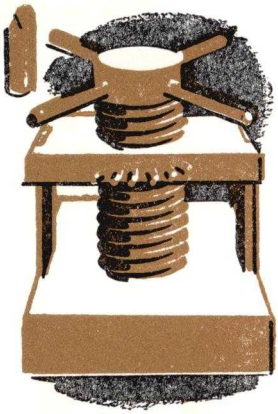


Fig. 2. Screw with pointed pegs engaging the screw threads. Detail of peg shown at left.

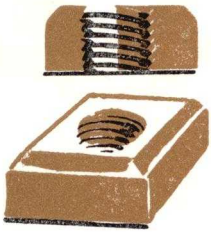


Fig. 3. Iron nut made by the Romans about 362 A.D.

According to Plinius, the Roman scientist, an invention of great technical importance was made around the year 60 A.D. Consisting of a heavy timber frame and two large wooden screws carved by hand, this invention was the screw press. Fig. 1 is a drawing made from a wall painting in Pompeii, the Italian city which was buried in volcanic ashes.

Notice that the two screws taper toward the top. Whether the screws were actually tapered or only represented in that manner is something that science has not yet been able to determine. However, the fact remains that screws were always shown as being tapered as late as the 15th Century.

These early screws had no corresponding interior or female threads. Instead, a smooth hole was bored through the plank or timber through which the screws were to pass. Pointed wooden pegs were then driven into this hole from the sides in such a way that they would engage the screw thread from its root or deepest part. (Fig. 2.)

In 362 A.D., Oribasius, physician to the Roman Emperor Julianus, wrote a very technical description of various types of machines and appliances in use at that time. He writes that both screws and nuts were made of iron, which was then a new metal. He was familiar, not only with the V-thread, but also with the square thread and the right and left thread. The nut, or bearing (Fig. 3), dates back to the Roman occupation of western Germany. It was found near the Rhine City of Bonn and was kept in the local museum, at least until the beginning of World War II.

The early screw presses were used for many purposes, such as cloth presses, wine presses and coin presses (stamping coins by pressure). Later on, in 1450, Johan Gutenberg used this type of press as the first printing press.

In the woodworking industry, veneer presses with wooden screws have been used for centuries and are still used in many old shops in Europe. Furthermore, wooden screws are still used for tightening the vises on cabinet makers' benches, and the use of such benches dates back to Roman times. Wooden screws were also used until quite recently both on bar clamps and handscrews.

Fig. 4. Screw boxes for cutting outside threads.

Originally, the larger diameter screws were carved by hand, but those of smaller diameter were not so easy to carve, because they had to be very accurate to work well. Later on, a screw box (Fig. 4), consisting of two pieces of wood bolted together and a V-shaped knife projected into a central hole, was used for cutting the outside threads. A corresponding steel tap (Fig. 5) was used for cutting the inside or female threads. These tools were substantially the same as those used for cutting threads on wood at the present time.

Fig. 5. Old taps for cutting interior threads in wood.

An ingenious method of cutting interior threads for large diameter screws is shown in Figs. 6 and 7. A hole, equal in diameter to the root diameter of the outside thread, is first bored in the stock to be threaded, after which a wooded cylinder is turned to fit the hole. The spiral is laid out on this cylinder and a sawcut made along it. At the upper end of the sawcut a triangular shaped knife is inserted into the cylinder. A guide block is now screwed to the back of the stock. One or two pieces of this metal, which are pitched to engage the sawcut, are fastened to it.

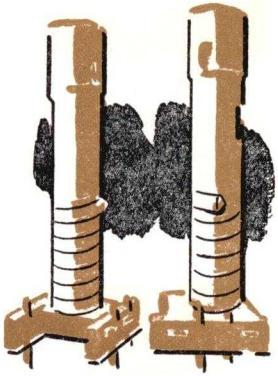


Fig. 6. Method of cutting interior thread for large diameter wooden screw.

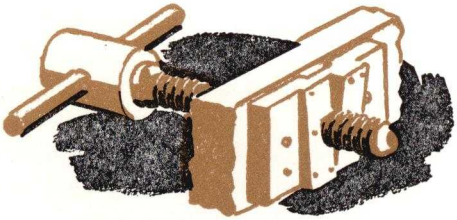


Fig. 7. Method of cutting exterior thread for wooden screws.

Fig. 8. French Iron Bar Clamp, 17th Century.

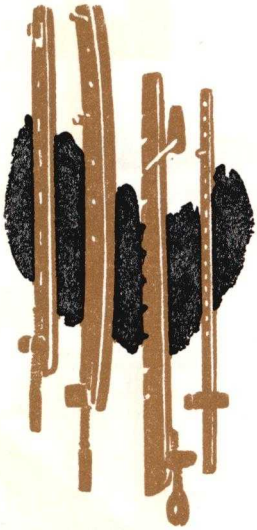


Fig. 9. 19th Century wooden bar clamps.

As the cylinder is turned into the hole, the guide plates cause it to advance at a certain uniform rate while the knife cuts the thread in the interior surfaces of the hole. The slot, cut in the guide block, permits the knife to go all the way through the hole. Two or three cuttings were generally necessary, the knife being advanced slightly after each cut.

The beginning of the modern clamp was the bar clamp (Fig. 8), which was used by French cabinet makers in the 17th Century. It was made of iron but had no screw because screws were still expensive to make. Instead, it had a slide, or jaw, which could be moved along the bar. The work was held between it and the bent end of the bar and the clamp was tightened or loosened by blows of a hammer on the slide.

The wooden bar clamps, shown in Fig. 9, were used by the early settlers of this country. Most of these clamps had a wooden screw, which turned in a frame, mortised at right angles into a wooden bar. Wedges or round pegs could be fitted into the bar at regular intervals. No matter how well made, this construction was inherently weak. An improved wooden bar clamp, with a wooden block fastened to an iron stirrup which held it firmly in slots cut in the underside of the bar, is shown both in Figs. 9 and 10A. The clamp in Fig. 9 was evidently used where only a light pressure was needed. The work was clamped between a peg and a moveable block fastened with a thumbscrew like a marking gauge.

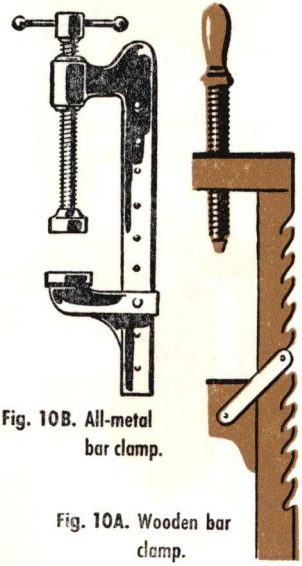


Fig. 10B. All-metal bar clamp.

Fig. 10A. Wooden bar clamp.

The all-metal bar clamp (Fig. 10B) was first used in Europe about 1876. Note that the slide is held in position on the bar with a steel pin passing through holes drilled in the bar.

The wooden screw clamp (Fig. 10C) has been used in Europe for centuries. The members of the frame are mortised together at right angles and these joints are sometimes reinforced with metal corner plates or a bolt.

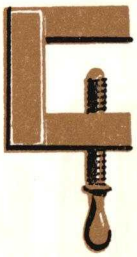


Fig. 10C All Wooden Clamp.

The handscrew was first made with wooden spindles (Fig. 11). The middle spindle passes through a smooth hole in the jaw nearest its handle, and through a threaded hole in the other jaw. The end spindle engages the jaw nearest its handle and enters a smooth hole bored part way through the other jaw. The smooth holes are therefore in the same jaw and the two threaded holes in the other. In clamping, the action of the middle spindle is to pull the jaws together, while the end spindle tends to push them apart. As the middle spindle also acts as the fulcrum, the end spindle forces the front ends of the jaws tighter on the work.

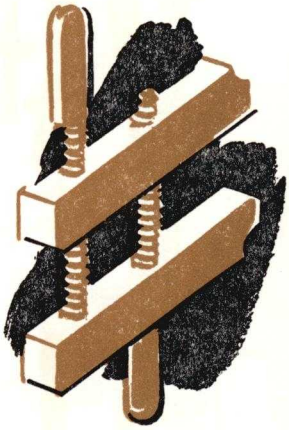


Fig. 11. Handscrew with wooden spindles.

Another medieval holding tool is called the "hold-fast". (Fig. 12.) It has been used for centuries both in Europe and in this country. It is still used by cabinet makers in Europe. The hold-fast is an iron rod, whose upper end is flattened and bent at right angles to the body of the rod. When driven into a hole bored for it in the bench top, the bent bar is forced against the upper surface of a board or plank while the body of the bar wedges in the hole thereby holding the stock firmly to the bench top.

Fig. 12. Hold-Fast.

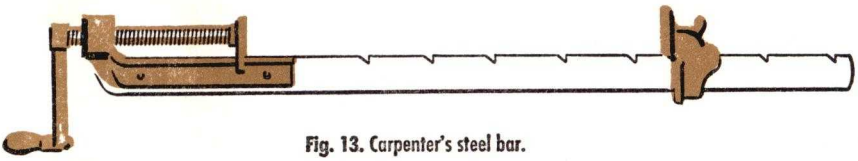


Fig. 13. Carpenter's steel bar.

Fig. 14. Cabinet clamp.

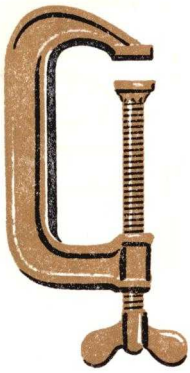


Fig. 15. Carriage Makers.

Fig. 16. Machinists' clamp.

Any discourse on clamps of the modern era would be lacking without tracing the prominent part played by **The Cincinnati Tool Co.** in the development of the present-day clamps as we know them.

The organization of **The Cincinnati Tool Company** in 1879, by Edward Hollister Hargrave, led to the introduction of the first steel Bar Clamp made in the United States. (Fig. 13.) The present line of Hargrave improved "I" Bar, Perfection Steel Bar and Extra Heavy Duty Bar Clamps are an outgrowth of this basic design.

During the period between 1879 and 1890 the counterparts of many of the present-day Hargrave Clamps appeared in the catalogs published by **The Cincinnati Tool Co.**

For instance, the old Cabinet Clamp (Fig. 14) was the forerunner of the present line of Hargrave Junior Clamps. The Carriage Makers' Clamp (Fig. 15), shown in the old catalog, is the predecessor of the present Hargrave Standard® Clamp. The name "Carriage" derives from the large quantities of these clamps that were used by the carriage makers years ago. The present "Standard" clamp is still used to some extent by the modern day "Carriage" industry . . . the automobile manufacturers.

The old Machinists' Clamp (Fig. 16) with a

malleable iron frame has given way to the modern line of **Hargrave Forged Steel Super Clamps.**

The Adjustable Screw Clamp (Fig. 17) eventually gave way to the present line of more efficient **Hargrave Quick Clamps** consisting of 12 patterns with depth (reach) of from 2″ to 9″ and any opening required.

Fig. 18 shows the outmoded Carvers' Clamp, itself an improved model of the ancient "holdfast". (Fig. 12). With the advent of multiple spindle carving machines, which duplicate in multiple a pattern carving, this Carvers' Clamp gradually went out of use.

The old Patent Self-adjusting Hand Screw (Fig. 19) was an early effort to make the jaws of a hand screw align themselves to work whose surfaces were not parallel. However, the advent of the adjustable Steel Spindle Hand Screw, which is simpler and more foolproof in design, made the Patent Hand Screw obsolete. The modern **Hargrave Hand Screw** (Fig. 20) is a great improvement over its wood spindled prototype. The spindles are made of steel and have right and left "Acme" threads, thus moving both jaws at the same time but in opposite directions.

Thus it is easy to see that the use of clamps, as such, dates back into ancient history. By tracing the development and usages of clamps into the medieval and modern times, the reader can readily understand the reasons for

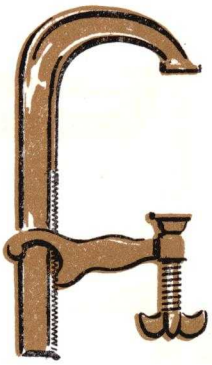
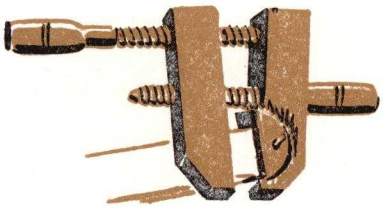


Fig. 17. Adjustable screw clamp.

Fig. 18. Adjustable Carvers' clamp.

Fig. 19. Self-Adjusting Hand Screw.



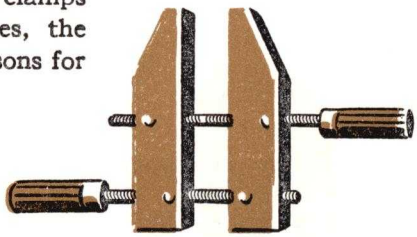


Fig. 20. Modern steel spindle handscrew.

our present clamp sizes, shapes and applications. Although basically of the same design-principle, our modern clamps are stronger, more efficient and certainly more economical to use. This is the history of clamps. The Cincinnati Tool Company is proud to have been a part of this segment of industry since 1879. Our contributions to the development of the present-day clamps are self-evident—self-evident to the extent that the world's largest users specify "Hargrave" clamps for their needs. Over one thousand of the leading Industrial Supply and Wholesale Hardware houses in the U. S. A. and foreign countries regularly stock and distribute Hargrave Clamps.

Hydraulic Clamp Tester, which quickly and accurately applies loads to 30,000 lbs. (15 tons). Today each HARGRAVE Standard Clamp, Body Clamp, and Superclamp is tested to more than its rated load. HARGRAVE Steel Bar Clamps are frequently tested to insure their efficiency.

Suggestions on the use of CLAMPS

The proper use of clamps is, to a great extent, obvious and a matter of applying common sense. However the following suggestions may be of assistance to the beginner.

Care—The finest made clamp, like other fine tools, can be ruined by rough handling, improper job selection, overloading, etc. Keep your clamps in racks when not in use, rather than throwing them in a pile. This will protect them from damage and insure a "usable" clamp when you need it.

Keep your clamps clean and occasionally lightly lubricate all moving parts for longer service and smoother operation. Make sure there is no oil on any part(s) that will come in contact with the work.

USE and SELECTION. Use clamps of proper capacity. You wouldn't expect to drive a railroad spike with a tack hammer—neither should a light-duty clamp be expected to perform beyond its ability, nor should a large, heavy-duty clamp be expected to perform satisfactorily where a small, light-duty clamp would suffice.

Consider first your clamping requirements, then select the clamp best suited to your needs by ascertaining: (1) Opening required (2) Depth required (3) Strength and weight required (load capacities are specified in our General Catalog) (4) Determine if full length screw is essential; if not, the resulting constant hindrance of extended screw beyond the frame can be eliminated by selecting a clamp with screw length proportionate to your need (5) Determine type of Handle best suited to your need (6) Evaluate the clamp operating time against the clamping need; i.e., do you require a Spring Clamp, "C" Clamp, Bar Clamp, etc. These appraisals of your clamping needs will assure you the most satisfactory operating applications by saving time, money and enhancing the life of the clamp.

The Bar Clamp is the basic clamp for most cabinet work. There are many applications, however, where "C" Clamps, Quick Clamps and Hand Screws are used to supplement the Bar Clamps.

EDGE-TO-EDGE JOINTS—In clamping a panel as in Fig. 21 alternate the clamps—one above and the next below—to prevent buckling of the stock. Draw all the clamps snug, starting with the center clamps, level the boards with a mallet or hammer and wood block, then draw the clamps tight. In some cases the work is such that the clamps can only be applied to one side, in which case to prevent buckling, it may be necessary to apply one or more battens as shown in Fig. 22. These battens can be held in place by "C" Clamps, Quick Clamps or Handscrews.

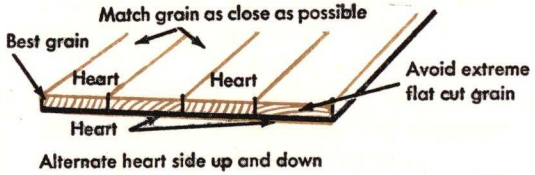


Fig. 21. Edge to edge joints require careful fitting. Clamps should be applied on both sides.

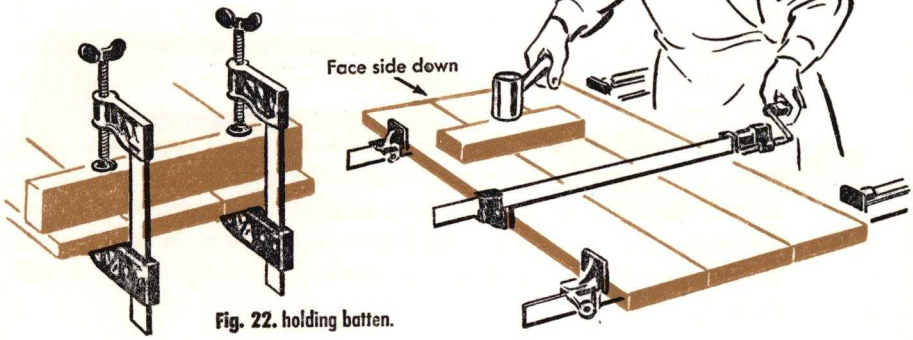


Fig. 22. holding batten.

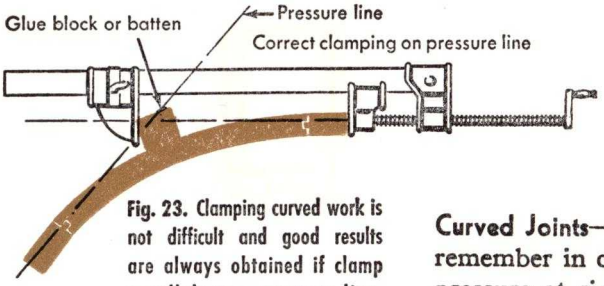


Fig. 23. Clamping curved work is not difficult and good results are always obtained if clamp parallels true pressure line.

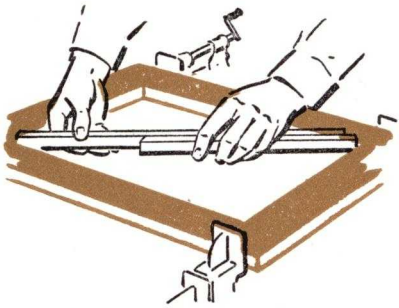


Fig. 24. First—test squareness with diagonals.

Fig. 25. Second—test squareness at each corner.

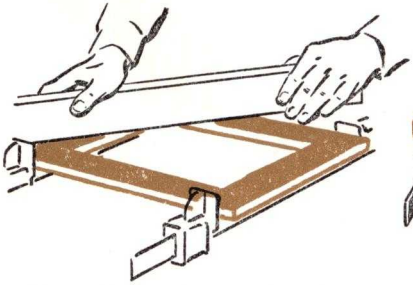


Fig. 26. Third—check surface flatness.

Curved Joints—One basic principle to remember in clamping is to keep the pressure at right angles to the joint. This is particularly true in gluing curved joints as illustrated in Fig. 23. The batten or glue block is either glued or clamped to the curved stock in such a position as to bring the line of clamping pressure vertical to the joint.

Framing—The operation of framing applies to any assembly of stiles and rails. It requires great attention to detail. The joints should be accurately machined and, in assembling, careful attention should be paid to squareness, flatness and twist.

Squareness can be checked by diagonal measurements (Fig. 24) and verified by checking with a square at each corner (Fig. 25). The distortion can be corrected by either shifting the clamps as in Fig. 27 or by applying a mitre frame clamp as in Fig. 28.

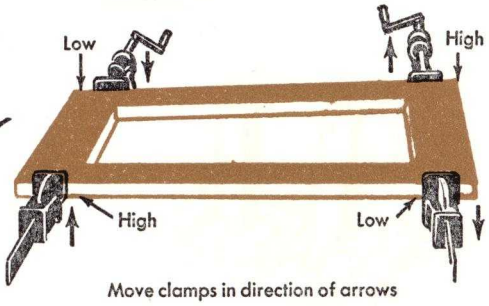


Fig. 27. Correction for twist.

Surface *Flatness* can be checked with a level or any straightedge. (Fig. 26). *Twist* can be detected by sighting down the frame, and can be corrected by moving the clamp jaws as indicated in Fig. 27.

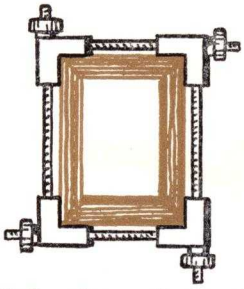


Fig. 28. Shows the new mitre frame clamp.

Miter Joints—The HARGRAVE FOUR CORNER MITER CLAMP does the job right. It clamps all four corners at one time and does not mar the work. Can be used on finished stock. Exceedingly flexible as to capacity. Quickly adjusted to any square or rectangle desired. Absolutely accurate and holds firmly until released. No slipping.

Adjusting Nuts can be quickly twirled to position and are shaped to give a good grip for tightening.

Miter joints can also be made using clamps only (Figs. 29A and 29B). This can be done by clamping blocks to the stock and applying pressure with a Quick Clamp, Bar Clamp, or Handscrew. Bear in mind that in this operation it is also necessary to keep the pressure line at right angles to the joint.

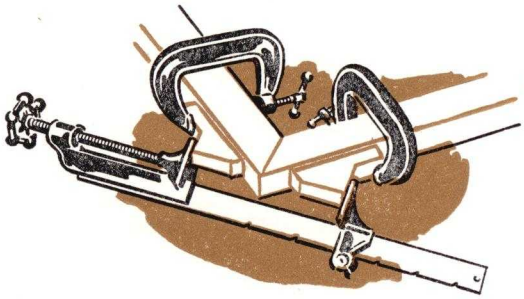
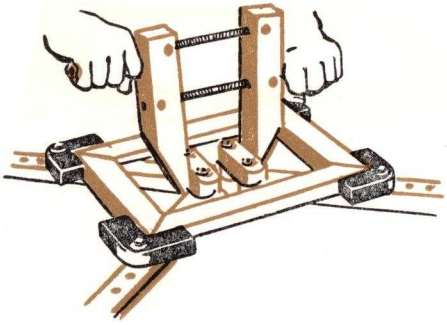


Fig. 29A. Clamping flat miter joint with use of clamped blocks

Fig. 30. Miter joints.



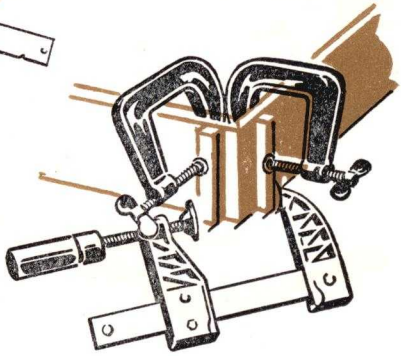


Fig. 29B. Ears applied to edge miter.

Veneering—Veneering is best done with a veneer press, but if a press is not available, a very satisfactory job can be done by using battens or bearers top and bottom and deep reach Quick Clamps, "C" Clamps or Handscrews (Fig. 31). If stock is wide, it is well to cut the battens or bearers with a slight curve so that pressure will also be applied at the center of the work.

A caul board should be used between the veneer and the battens to insure the pressure being applied over the entire veneered surface. This will prevent blistering of the veneer. It is often advisable to use paper between the veneer and the caul board.

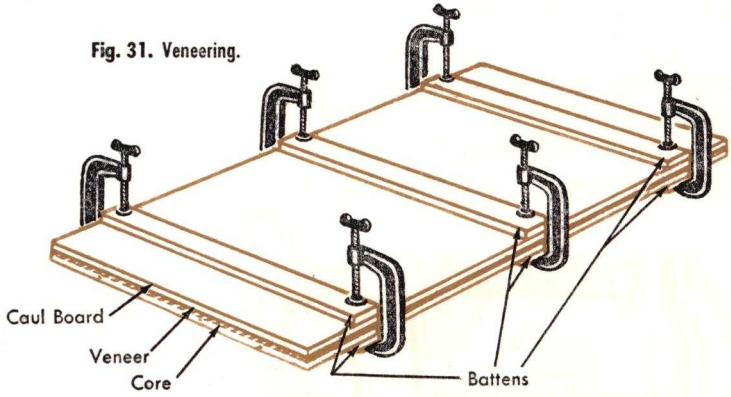
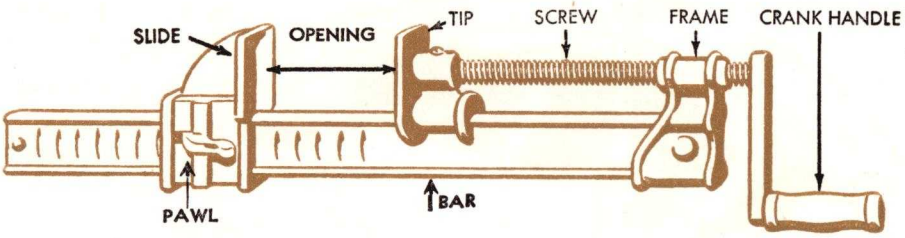


Fig. 31. Veneering.

Today the clamp user, whether he uses clamps on woodworking, welding or machine shop work, can find the right clamp for the right job at the right time in the more than seventy-five patterns and over 226 sizes of Hargrave Clamps.

Remember ECONOMY cannot be based or judged on original cost—only on service adaptability, quality of material and workmanship. **The Cincinnati Tool Company** prides themselves on their constant endeavor to maintain the highest standard on these three important factors.

GLOSSARY OF CLAMP TERMS

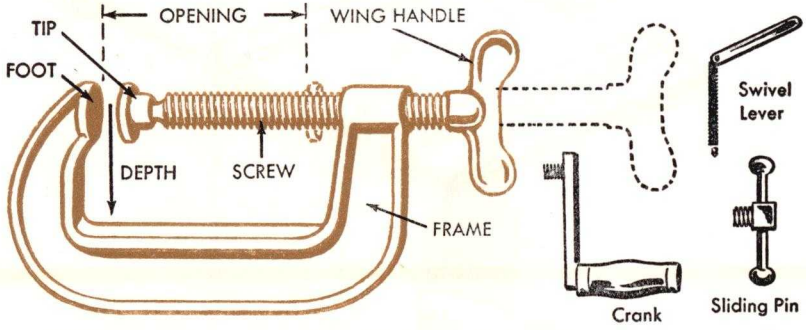


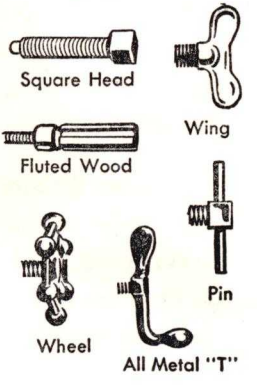
Frame—That part of a "C" Clamp, Quick Clamp or Bar Clamp which has a threaded bearing for the adjusting screw.

Tip—The pressure plate, or jaw, on the end of the screw.

Slide—The lower jaw on the steel bar clamps, which is adjusted on the bar to an approximate opening before pressure is applied with the screw.

Screw—This is turned by various methods on different patterns of Clamps. Types of handles are Pin, Sliding Pin, Swivel Lever, All Metal T, Wheel, Wing, Crank.





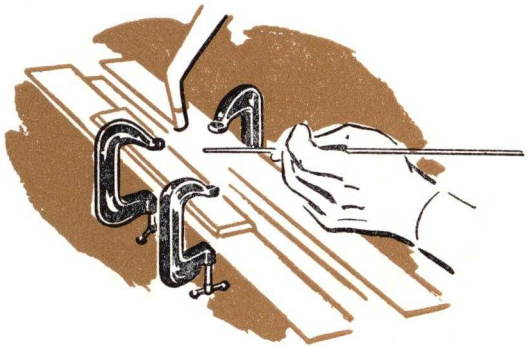
The Foot is the flat surface at the lower end of the "C" Clamp frame.

Opening is the distance between jaws with the clamp opened to its greatest capacity.

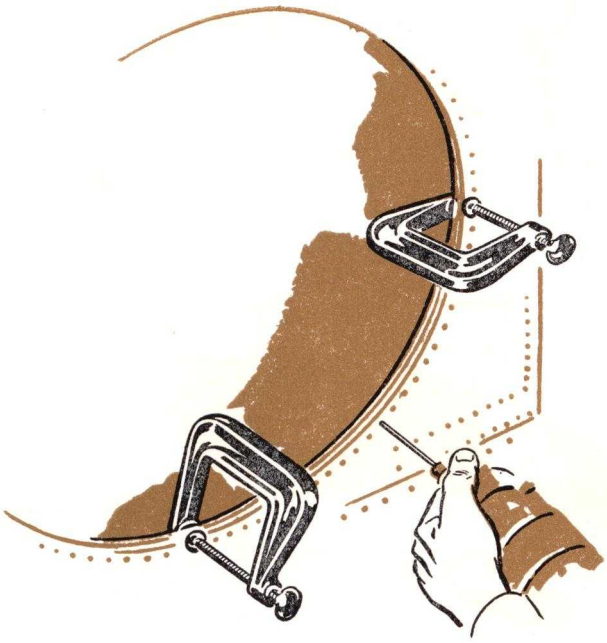
Depth is the distance from the center of the screw to the inner edge of the frame in the case of the "C" Clamps and to the inner edge of the bar on the Quick Clamps.

METALWORKING APPLICATIONS OF CLAMPS

Spot welding with Hargrave spring clamps.

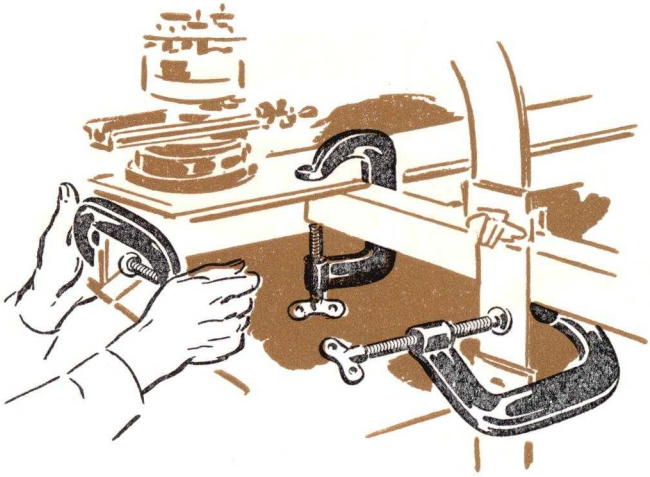


Welding with "C" Clamps.



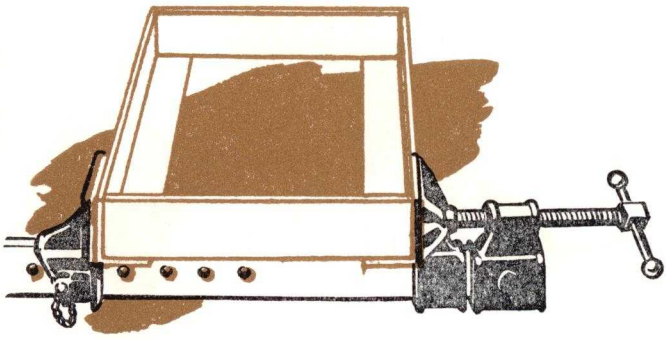
"C" Clamp to hold plates for drilling.

METALWORKING APPLICATIONS OF CLAMPS



Welding with
Forged Steel Clamp.

Seam welding
with spring clamp.



#750 Heavy duty bar clamp
lding body members together
for welding.

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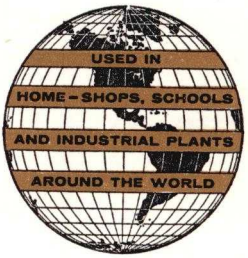

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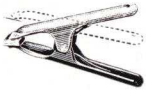

SMALL "C" CLAMPS

STANDARD CLAMP

FORGED STEEL REG. DUTY

FOR MEDIUM-HEAVY DUTY

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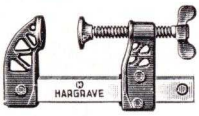

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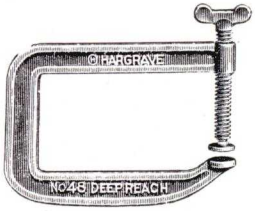

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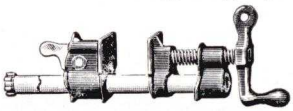

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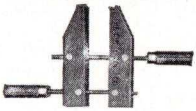

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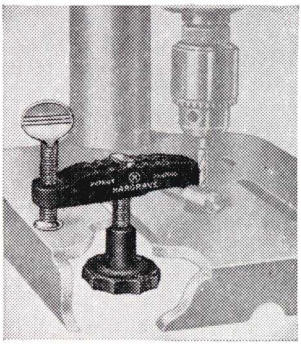

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